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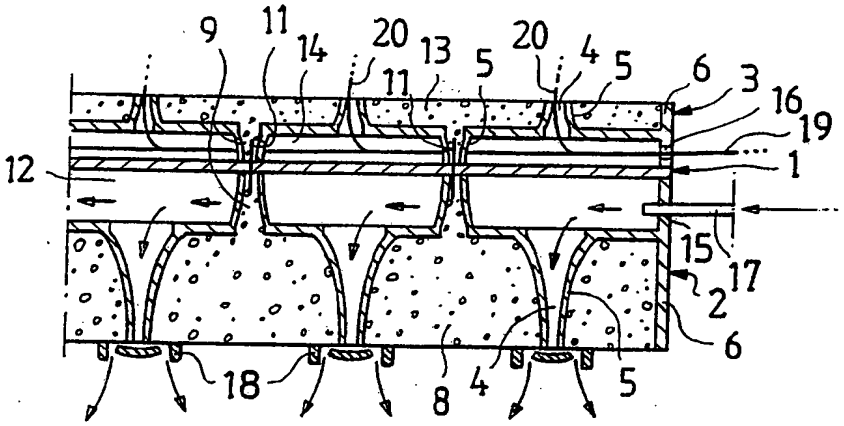

(57) Abstract

The invention relates to a method for producing a sandwich-structured intermediate floor or a similar wall structure, and to a structure produced by the method. Into the structure there is incorporated a layer (1) against which there is placed a primarily flat form (2, 3) equipped with apertures (4) and with sleeve-like projections (5) framing the apertures, in such a manner that by means of the projections a hollow space (12, 14) is produced between the form and the said layer (1). A layer of a setting mix (8, 13) is cast on the form (2, 3) so that the mix will penetrate inside the projections (5) and bind via them the different layers of the structure to each other. In practice it is essential that the form (2, 3) has sleeve-like projections (5) framing the apertures (4) on both sides of the form and that in the casting step the projections on the top side of the form are left open so that they will constitute a connection from the hollow space to the outside of the structure. In the invention, preferably two forms (2, 3) are used by means of which there are obtained in the structure two separate hollow spaces (12, 14) which communicate via apertures (4) with the opposite sides of the structure. The hollow spaces (12, 14) with their apertures (4) can be used, for example, for arranging ventilation or cable connections for the room spaces below and above the intermediate-floor structure.

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+ DESIGNATIONS OF "SU"

Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

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Method for producing an intermediate floor or a like wall construction with a sandwich structure and a wall construction produced by the method

The present invention relates to a method for producing a sandwich-structured intermediate floor or a similar wall structure, in which method a primarily flat form equipped with apertures and sleeve-like projections framing the apertures is placed against one layer of the structure in such a manner that by means of the projections a hollow space is obtained between the form and the said layer, and in which method a layer of a setting mix is cast on the form in such a manner that the mix will penetrate inside the projections and via them bind the said layers of the structure to each other.

In intermediate floors of buildings, hollow-core slabs having oblong tubular voids running from one end of the slab to the other have been used. These voids can be used as ventilation ducts, and telephone or electrical cables and other such connections can be drawn via them.

Also known is an intermediate floor in which a substantially continuous hollow space has been obtained in the structure by means of a flat form piece. This prior-known intermediate floor structure is constructed by placing on a solid layer of concrete or some other similar material a flat form piece having apertures each of which is framed by a sleeve-like projection. These projections will come against the solid layer of material in such a manner that by means of them the said mainly continuous hollow space is formed inside the structure. In the subsequent casting step a layer of concrete is applied on the form in such a manner that the concrete will fill the sleeve-like projections surrounding the apertures in the form and will thus form bridges which will bind to each other the layers of the structure obtained. The hollow space of the obtained

intermediate-floor structure is also in this case suitable for the installation of horizontal ventilation ducts, cables, and piping.

The object of the present invention is to provide an alternative in which, in accordance with the prior-art technology described above, there is utilized a primarily flat form, incorporated into the structure and provided with apertures and with sleeve-like projections surrounding the apertures, but in which the hollow space formed in the structure can be used in a more versatile manner than previously. The method according to the invention is characterized in that therein a form is used which has, on both sides of the form, sleeve-like projections which surround the apertures, and that in the casting step the projections on the top side of the form are left open so that in the structure being produced they will form a connection from the hollow space to the outside of the structure.

By means of the invention the essential advantage is achieved that the ventilation ducts, telephone cables, electrical cables, and the like installed in the hollow space can be directed not only in the longitudinal direction from one edge of the structure to the other but also to the sides of the structure via the apertures produced by means of the projections. This means that, for example, in an intermediate floor between different storeys of a building, ventilation for the lower storey can be arranged from the ceiling by directing the ends of the ventilation ducts into the apertures produced, in accordance with the invention, in the ceiling. In a corresponding manner, electrical cabling can be drawn to the apertures in the ceiling, for example in order to provide ceiling lighting.

By applying the invention it is possible to form a sandwich-structured intermediate floor or the like, having two hollow spaces which open to different sides of the structure. In this case the procedure is that two forms equipped with apertures

are used, each form having on both sides of the form sleeve-like projections framing the apertures. These forms are arranged on different sides of the intermediate layer left inside the structure, and layers of mix are cast on them in such a manner that in the structure obtained the forms will delimit two separate hollow spaces which communicate with the opposite sides of the structure via the projections left open on the casting side.

The structure mentioned above is in practice preferably produced by first casting on one of the forms a layer of a setting mix, which will fill those projections of the form which are at this stage on the bottom side, while the projections on the top side of the form will remain open. After the casting step, or possibly simultaneously with it, a preferably flat, solid intermediate layer is fastened on the said bottom side of the form by means of ties to be embedded into the mix filling the projections. Next, a second form is placed against the intermediate layer in such a manner that the projections belonging to it will come into alignment with the ties provided in the intermediate layer. Ultimately, a layer of mix is cast on the latter form in such a manner that the mix will fill the said projections set in alignment with the ties of the intermediate layer and will thus be bound by mediation of the ties to the intermediate layer, while the casting-side projections of the form are left open.

If in the manufacturing method described above the forms are brought against the intermediate layer in such a manner that the ends of projections belonging to different forms come into alignment, the intermediate layer can be bound on each side to the mix filling the projections by means of common ties passing through the intermediate layer.

In order to facilitate the casting of the mix, each of the forms can be equipped with edge strips the height of which

corresponds to the combined height of the projections on the different sides of the form, in which case the edge strips, possibly together with the edges of the intermediate layer, will form closed edges in the cast structure obtained. Subsequently, apertures leading to each hollow space are opened in these edges so that the hollow spaces will be available for use for ventilation, for the drawing of electrical or telephone cables, or for other similar purposes.

According to the invention, the setting mix used for the cast layers is preferably concrete. However, cellular plastics such as polyurethane and polystyrene, which are suitable for lighter-structured intermediate floors and partition walls, are also possible. The intermediate or other layers belonging to the structure, and the forms, are for their part preferably of non-combustible plastic sheet but may also be of some other material, such as steel sheet.

The invention also relates to a sandwich-structured intermediate floor or other similar wall structure produced in accordance with what has been described above. The structure comprises at least one, preferably solid layer of material, a cast layer of a set mix linked to it, and between the said layers a substantially flat form; by means of sleeve-like projections belonging to the form a hollow space is obtained between the form and the first-mentioned layer, whereas the mix which has penetrated inside the projections will serve as a bridge which binds the layers to each other. The essential idea in the intermediate floor according to the invention is that, in addition to the projections filled with the cast mix on the side facing the first-mentioned layer, the form has sleeve-like projections directed to the opposite side of the form and running through the cast layer, the apertures inside these projections forming a connection from the hollow space to the outside of the structure.

As regards the various embodiments of the intermediate floor according to the invention, reference is made to the above description of the method and to the accompanying patent claims.

The invention is described below in greater detail with the help of an example and with reference to the accompanying drawings, in which

Figure 1 is an exploded view of the intermediate layer belonging to one intermediate floor according to the invention and of the forms on its both sides,

Figure 2 is a section through II-II in Figure 1,

Figure 3 depicts the first step of the manufacture of the intermediate floor, in which a layer of concrete has been cast on one of the forms,

Figure 4 depicts the subsequent step, in which the form has been turned over and the intermediate layer has been fastened to it,

Figure 5 depicts the subsequent step, in which a second form has been placed on top of the intermediate layer,

Figure 6 depicts the final step of the manufacture, in which a layer of concrete has been cast on the last-mentioned form, and apertures have been opened into the hollow spaces formed in the intermediate floor, through which apertures ventilation ducts and electrical cabling have been directed via the hollow spaces to the lower and upper sides of the intermediate floor, and

Figure 7 depicts a corner of an intermediate floor produced according to Figures 3-6, as seen obliquely from below.

Figures 1 and 2 depict a portion of the elements used in the intermediate-floor structure according to the invention as an exploded view, i.e. in the order in which they come in the structure. These elements comprise an intermediate layer 1 made up of a flat, solid sheet, preferably of a non-combustible plastic material. On both sides of the intermediate layer 1 there are located substantially flat form pieces 2, 3, the area

of which is the same as that of the intermediate layer. The form pieces 2, 3 are solid with the exception of apertures 4, which are framed with sleeve-like projections 5. It can be seen in Figure 2 that each form piece 2, 3 has sleeve-like projections 5 on both sides of the form. In the example case depicted, the size of the projections 5 varies so that in the form piece 2, lower in the figures, the projections have greater height than in the upper form 3, and furthermore in the lower form piece they have greater height on the lower side (which in the casting step according to Figure 3 is the top side of the form) than on the top side. Each form piece 2, 3 is further equipped with edge strips 6 the height of which corresponds in each form the combined height of the projections 5 on its different sides. This means that, when the intermediate layer 1 and the form pieces 2, 3 are brought against each other, each side of the intermediate layer will be located against the ends of the sleeve-like projections 5 of the forms, the edge strips 6 and the edges 7 of the intermediate layer forming for the intermediate-floor structure closed edges the width of which corresponds to the final thickness of the structure obtained (cf. Figures 6-7).

The producing of the intermediate floor is commenced by casting a layer of concrete 8 on the form 2 located under the intermediate layer 1 in Figures 1 and 2. During the casting the form 2 is, in accordance with Figure 3, in a position upside down as compared with Figures 1 and 2. The concrete layer 8 is cast up to the level of the ends of the casting-side projections 5 of the form 2 and the upper edge of the edge strips 6, in such a manner that the apertures 4 delimited by the said projections and passing through the form are left open. On the other hand, the concrete cast will penetrate inside the projections 5 on the opposite side of the form 2, blocking 9 the apertures delimited by the projections. For the duration of the casting, the latter-mentioned apertures are closed by means of plugs 10 of, for example, felt, which will prevent the concrete from

flowing via the openings through the form piece 2. The plugs 10 are removed as soon as the concrete has set.

In Figure 4, the form 2 according to Figure 3, provided with a concrete layer 8, has been turned upside down, and on top of it has been placed a solid sheet 1, which will constitute the intermediate layer in the completed intermediate floor. This intermediate sheet 1 has been fastened to the concrete 9 which fills the projections 5 of the form piece 2 by means of ties 11, which in Figure 4 are spikes struck through the sheet 1. These spikes 11 can also be seen in Figures 1 and 2.

It should be pointed out in this connection that the fastening of the intermediate sheet 1 to the form piece 2 can alternatively be carried out already in the casting step according to Figure 3, by placing a sheet 1, equipped in advance with ties, under the form 2 in such a manner that the ties will come inside the projections to be filled with concrete and by subsequently casting the concrete, in which case the concrete, upon setting, will bind the form to the intermediate sheet by mediation of the ties.

By means of the intermediate sheet 1 fastened to the form piece 2, there has been delimited in the structure a hollow space 12 which is continuous, with the exception of the projections 5 filled with concrete 9, and communicates to the sides of the structure via the apertures 4 delimited by the projections 5 on the opposite side of the form.

In Figure 5, a second form piece 3 has been placed on top of the structure obtained in accordance with Figure 4, so that its bottom-side projections 5 come into alignment with the ties 11 projecting from the intermediate sheet 1. Thereafter a layer of concrete 13 is cast in accordance with Figure 6 on the form 3. The concrete 13 will cover the form 3 up to the level of the ends of its casting-side projections 5 and the upper edge of

the edge strip of the form, at the same time penetrating inside the bottom-side projections of the form, surrounding the ties 11 inside them and thus binding the form to the intermediate sheet 1 which constitutes the intermediate layer of the form. By means of the form piece 3 and the concrete casting 13, there is thus obtained in the structure a second hollow space 14, which opens to the sides of the structure via the top-side projections 5 of the form 3, which were left open in the casting step. In other words, in the obtained intermediate-floor structure according to Figure 6, there are two separate hollow spaces 12, 14, which communicate, via the apertures 4 delimited by the sleeve-like projections 5 which pass through the concrete layer 8, 13, with the opposite sides of the structure, i.e. the lower hollow space 12 with the side below the structure and the upper hollow space 14 with the side above the structure.

The intermediate-floor structure obtained after the last casting step is solid, with the exception of the apertures 4 delimited by the projections 5. In Figures 6 and 7, apertures 15, 16, leading into the hollow spaces 12, 14, have been opened in the edge strips 6 of the form pieces 2, 3 on the edge of the structure. To the apertures 15 leading to the lower hollow space 12 there are linked ducts 17, which blow air via the hollow space into the apertures 4 delimited by the projections 5 and from the valves 18 installed at the mouths of the apertures into the room space below. By means of the intermediate-floor structure according to the invention, ventilation via the ceiling has thus been obtained for the room space. On the other hand, in the upper hollow space 14 of the intermediate floor there have been drawn, via the apertures 16, cables 19, and the branches 20 of the cables have been brought via the apertures 4 on the top-side of the structure into the upper room space. These cables may be, according to need, for example electrical or telephone cables, and it is also possible that the structure according to the invention is used in a similar manner for

leading water piping to the room spaces.

For an expert in the art it is evident that the various embodiments of the invention are not restricted to the example presented above but may vary within the scope of the accompanying claims. Thus it is possible that there is produced in the intermediate floor only one hollow space which communicates via apertures with a room space either above or below the intermediate floor. The intermediate layer according to the above example, which is of a rather thin plastic sheet or the like can in this case be replaced by a thicker, solid concrete layer which will serve as the bottom or top surface of the structure. The latter alternative is also applicable in a case of a ceiling structure which has apertures into the room space below and is closed on its upper side. It is also possible that the invention is applied to partition walls or even to the exterior walls of a building, in which the structure will, in a manner deviating from that presented in the example, be in a vertical position.

One advantageous target for the application of the invention consists of sections which are built in exhibition halls or on other similar exhibition premises for the duration of an exhibition, and in which the floor, wall and ceiling structures must be light in weight and must make possible the installation of not only the often electrically operated devices on display but also of any necessary ventilation and illumination equipment. Structures which are made up of plastic form sheets and intermediate sheets and of cast cellular-plastic layers and via the hollow spaces of which any necessary electrical cabling and ventilation ducts can be directed to precisely the desired points are suitable for this purpose. It is, for example, possible to arrange lighting and the blowing of cool air in the ceiling of the section, blowing of warm air in the floor of the section, and electrical connections for the displayed devices in the floor and/or walls of the section, according to need in

any given case.

Other possible applications of the invention to be pointed out include the floor and ceiling structures of automobiles and other vehicles. In these, for example, cast cellular plastics combined with form parts of steel or other such metal can be used.

Claims

1. A method for producing a sandwich-structured intermediate floor or a similar wall structure, in which method a primarily flat form (2, 3) equipped with apertures (4) and with sleeve-like projections (5) framing the apertures is placed against one layer (1) of the structure in such a manner that a hollow space (12, 14) is produced between the form and the said layer by means of the projections, and in which method a layer of a setting mix (8, 13) is cast on the form in such a manner that the mix will penetrate inside the projections and bind via them the said layers of the structure to each other, characterized in that in the method a form (2, 3) is used which has projections (5) framing apertures (4) on both sides of the form, and that in the casting step the projections on the top side of the form are left open so that in the structure produced they will constitute a connection from the hollow space (12, 14) to the outside of the structure.

2. A method according to Claim 1, characterized in that in the method two forms (2, 3) equipped with apertures (4) are used, each form having sleeve-like projections (5) framing the apertures on both sides of the form, the forms being arranged on different sides of the intermediate layer (1) left inside the structure and there being cast, on the forms, layers of mix (8, 13) in such a manner that in the structure obtained the forms will delimit two separate hollow spaces (12, 14) which will communicate with the opposite sides of the structure via the casting-side projections which remain open.

3. A method according to Claim 2, characterized in that the structure is produced by casting on a form (2) a layer of a setting mix (8) in such a manner that the mix will fill the projections (5) on the bottom side of the form during the casting step, while the projections on the top side of the form will remain open, that in the casting step or thereafter a preferably solid intermediate layer (1) is fastened to the said

bottom side of the form by means of ties (11) to be embedded in the mix filling (9), and that thereafter a second form (3) is placed against the intermediate layer in such a manner that the projections (5) belonging to it will come into alignment with the ties (11) provided in the intermediate layer, and that ultimately a layer of mix (13) is cast on the latter form in such a manner that the mix will fill the projections placed in alignment with the ties in the intermediate layer, thus being bonded to the intermediate layer by the mediation of the ties, while the casting-side projections of the form remain open.

4. A method according to Claim 3, characterized in that the forms (2, 3) are placed against the intermediate layer (1) in such a manner that the ends of the projections (5) belonging to the different forms will come into alignment, and that the intermediate layer is bound on each side to the mix (9) filling the projections by means of common ties (11) passing through the intermediate layer.

5. A method according to any of the above claims, characterized in that each form (2, 3) has edge strips (6) the height of which corresponds to the combined height of the projections (5) on the different sides of the form, the edge strips constituting at least part of the closed edges of the structure obtained, and that apertures (15, 16) leading to each hollow space (12, 14) are opened in the edges in such a manner that the hollow spaces can be used for ventilation, for the drawing of cables (19, 20), or for other such purposes.

6. A sandwich-structured intermediate floor or other similar wall structure produced according to any of the above claims, which structure comprises at least one preferably solid layer of material (1); a cast layer (8, 13) of set mix, connected thereto; and between the said layers a substantially flat form (2, 3), there having been a hollow space (12, 14) produced, by means of sleeve-like projections (5) belonging to

the form, between the form and the first-mentioned layer (1), the mix (9) which has penetrated inside the projections serving as a bridge which fastens the layers to each other, **characterized** in that the form has, in addition to the projections (5) which are filled with cast mix (9) and face the first-mentioned layer (1), also sleeve-like projections (5) which are oriented towards the opposite side of the form and pass through the layer of mix (8, 13), the apertures (4) inside them forming a connection from the hollow space (12, 14) to the outside of the structure.

7. A structure according to Claim 6, **characterized** in that it preferably comprises a solid intermediate layer (1), on both sides of this layer forms (2, 3) provided with sleeve-like projections (5), the forms delimiting between the forms and the intermediate layer hollow spaces (12, 14), and cast exterior layers (8, 13) against the forms, and that the sleeve-like projections (5) passing through the exterior layer and being open on the inside constitute connections (4) from the hollow spaces to the opposite sides of the structure.

8. A structure according to Claim 7, **characterized** in that the ends of the projections belonging to different forms (2, 3) are located in alignment against the intermediate layer (1), and that the intermediate layer is bound to the mix (9) filling the projections on its different sides by means of common ties (11) passing through the intermediate layer.

9. A structure according to Claim 7 or 8, **characterized** in that each form (2, 3) has an edge strip (6) the height of which corresponds to the combined height of the projections on the different sides of the form, the edge strip constituting part of the edges of the structure, and that the edge of the structure is, in the area of each hollow space (12, 14) provided with at least one aperture (15, 16) leading to the space.

10. A structure according to any of Claims 6-9, characterized in that the said layer of material (1), as well as each form (2, 3) between this layer and the cast layer (8, 13), is of plastic sheet.

11. A structure according to any of Claims 6-9, characterized in that the said layer of material (1), as well as each form (2, 3) between this layer and the cast layer (8, 13), is of metal, such as steel sheet.

12. A structure according to any of Claims 6-11, characterized in that the cast layer is of concrete.

13. A structure according to any of Claims 6-11, characterized in that the cast layer is of cellular plastic.

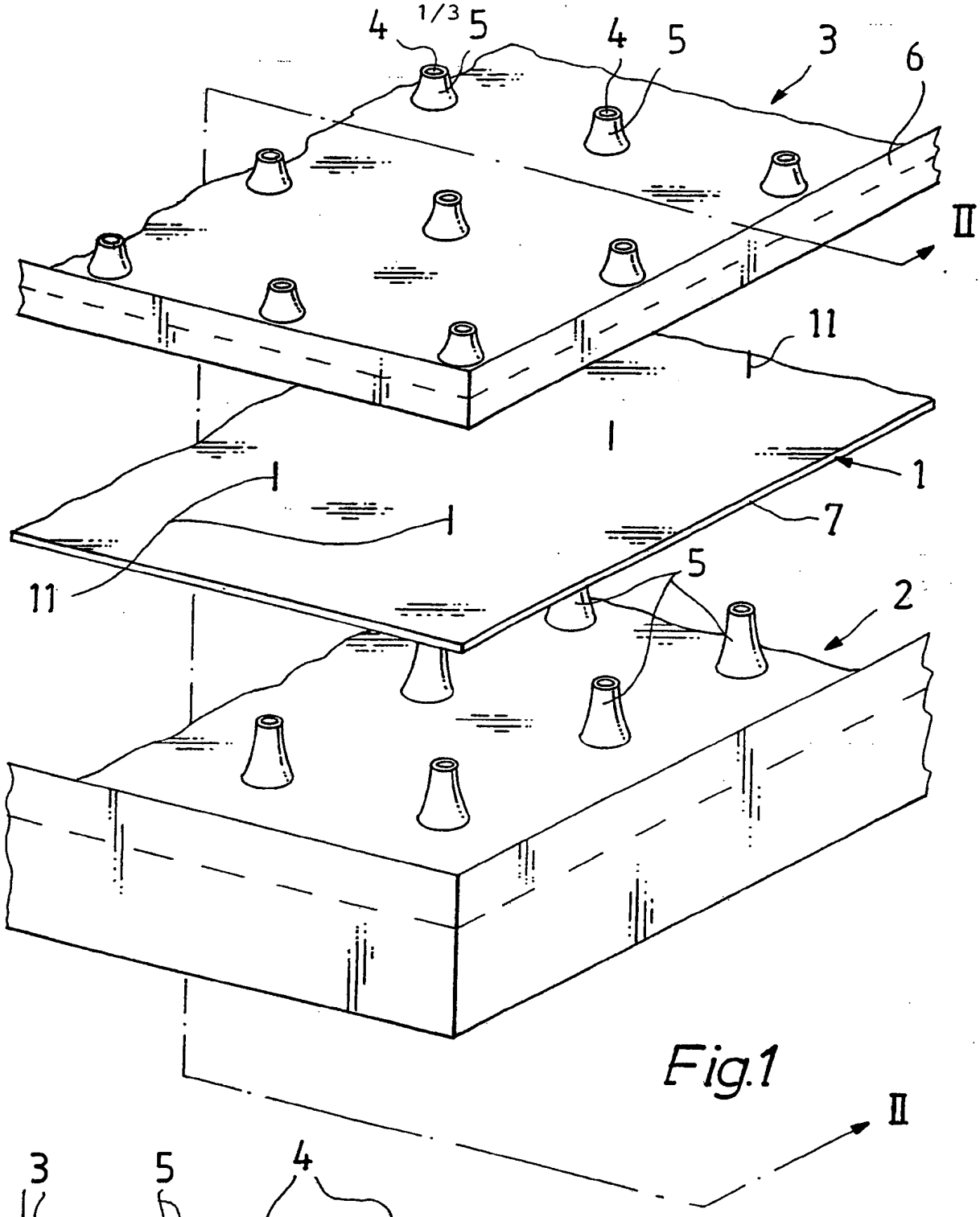

Fig.1

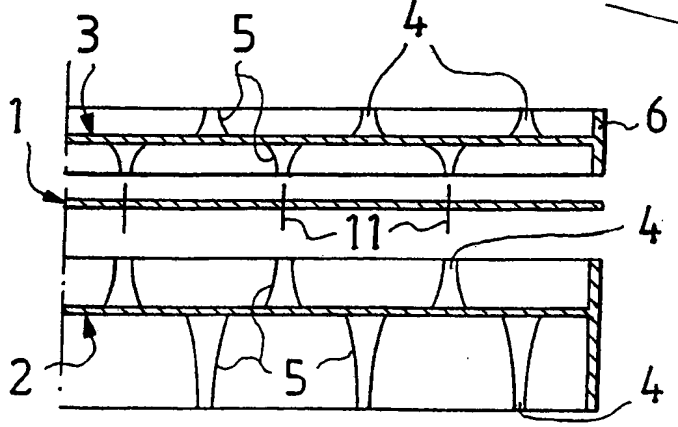

Fig.2

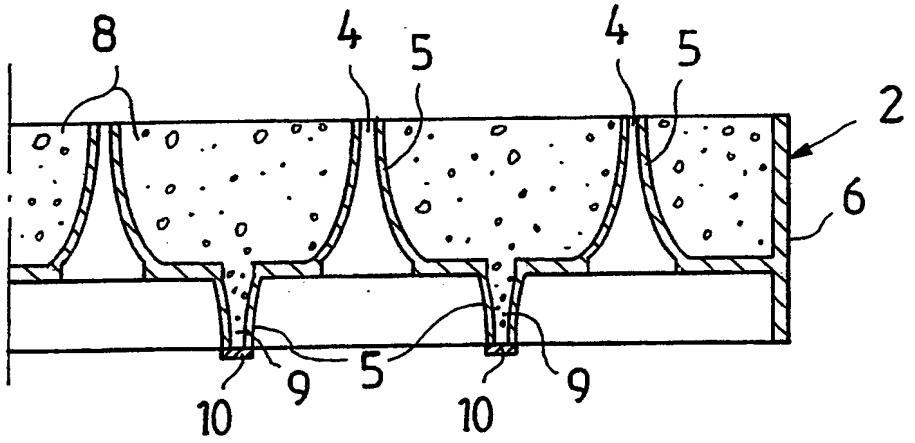

Fig.3

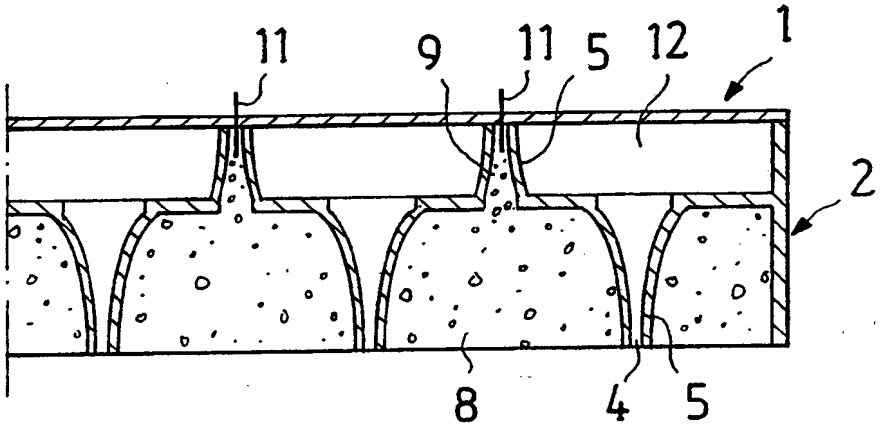

Fig.4

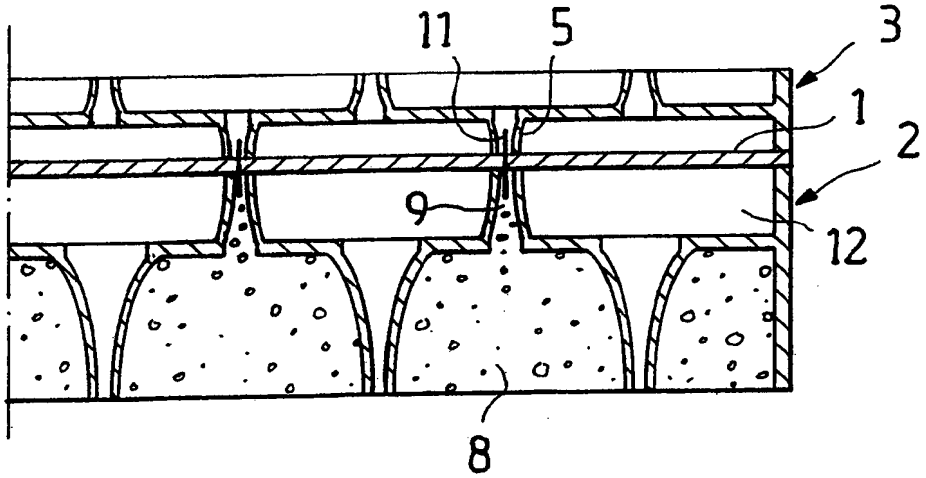

Fig.5

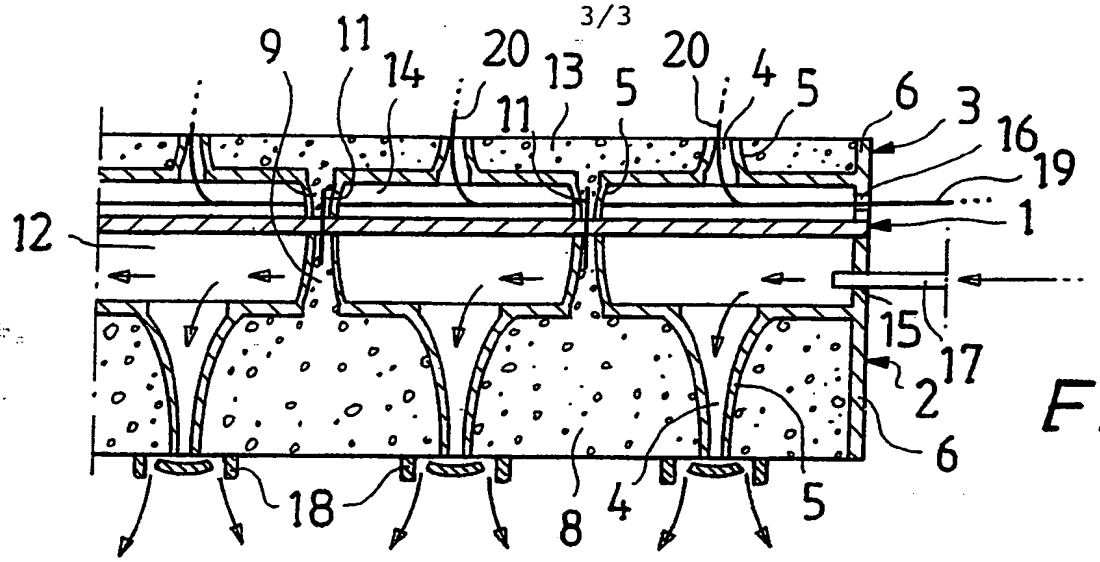
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Fig.6

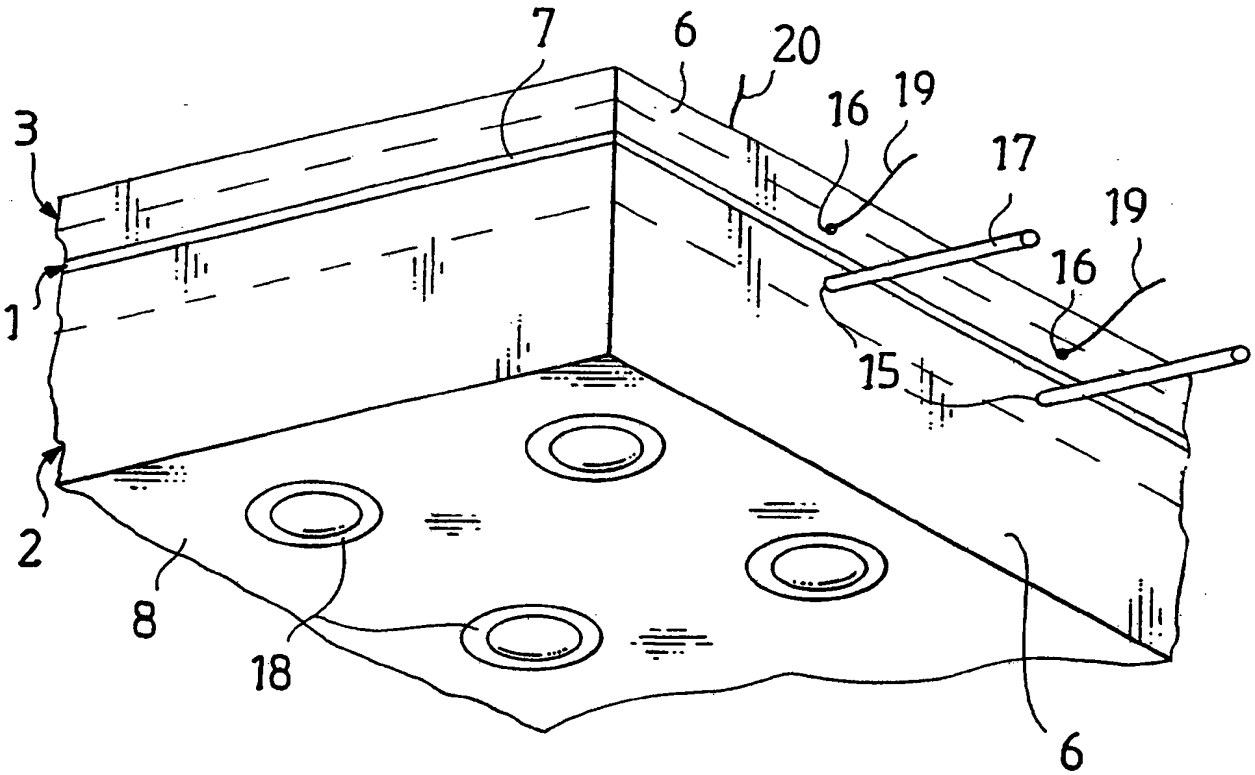
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Fig.7

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI 91/00337

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: E 04 B 5/48

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	E 04 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	GB, A, 1353974 (J.P. SKINNER) 22 May 1974, see the whole document --	
A	GB, A, 2214947 (D. HERBST) 13 September 1989, see the whole document --	
A	EP, A2, 0127037 (SCHMIDT REUTER INGENIEURGESELLSCHAFT MBH) 5 December 1984, see the whole document --	
A	EP, A2, 0133556 (GOLDBACH GMBH HOLZ-, KUNSTSTOFF- UND METALLVERARBEITUNG) 27 February 1985, see the whole document --	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
13th February 1992	1992 -02- 17
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Örjan Nylund

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 3908323 (STOUT) 30 September 1975, see the whole document --	
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A	FI, B, 45086 (R. M. CASTREN) 30 June 1971, see the whole document --	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/FI 91/00337

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 30/11/91 The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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